Adams write-up - not used - see CALT-473-9

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Crystallographic Dependence of a Dislocation Etch for Zinc Single Crystals*

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Additional observations have been made on the crystallographic dependence of a dislocation etch for zinc single crystals originally developed by Brandt, et al.[1] The original work confirmed that the etch technique was suitable for revealing basal and nonbasal dislocation intersections with $\{10\bar{1}0\}$ prism planes. A new set of crystal surface orientations has been found where etch pits are revealed. A 2 in. diameter hemispherical crystal of 99.999 per cent purity zinc was etched and etch pits were found on all surfaces located between 3° and 12.2° to the $[0001]$ axis. Figure 1 shows the regions of good, marginal and poor etching.

Attempts to etch the (0001) basal plane were generally unsuccessful although it was found that by etching freshly cleaved surfaces some etch pits were revealed that were obviously associated with twinning damage. A fresh surface was produced by quenching a specimen in methanol immediately after cleaving it in liquid nitrogen. No further attempts were made to etch (0001) planes because it is generally undesirable to subject large specimens to the thermal strains involved in the quenching process.

Figure 2 shows etch pits produced on a crystal surface whose normal is oriented 10° from the $[0001]$ and 80° from the $[11\bar{2}0]$ axes. The etch pits are associated with damage produced by two razor blade scratches oriented parallel and perpendicular to the basal plane trace. The line with arrows indicates the basal plane trace and the dark lines emanating from the scratches are twins. Etch pits can be seen lined-up in the general direction of the three $\{1\bar{2}12\}$ second order pyramidal slip plane traces. Nonbasal $\{1\bar{2}12\}$ type dislocations are therefore assumed to be revealed on planes within 3° to 12.2° to the [0001].

An experiment was conducted to establish whether basal dislocations are revealed in the region between 3° and 12.2° to the [0001] axis. A 1/4 in. diameter flat area was exposed at the [0001] pole of the 2 in. diameter crystal by cleaving in liquid nitrogen. A brass rod was glued to the flat surface with Eastman 910 adhesive. The crystal was held stationary while the rod was twisted 10° about the [0001] axis thus causing basal slip. The etched specimen revealed pile-ups of dislocations along the circular basal plane traces near the [0001] pole as shown in Figure 3. The exact orientation of the region showing dislocation pile-ups is not known.

The observations lead to the conclusion that both basal and nonbasal dislocations can be revealed on crystal surfaces oriented between 3° and 12.2° to the [0001] direction.

References

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1 R. C. Brandt, K. H. Adams and T. Vreeland, Jr., J. Appl. Phys. 34, 587 (1963).

Figure Titles

Fig. 1. Crystallographic dependence of etch.

Fig. 2. Etch figures on zinc crystal surface 10° to [0001] and 80° to $[11\bar{2}0]$. Line with arrows indicates basal plane trace. Magnification X 100.

Fig. 3. Etched zinc surface of twisted specimen near [0001]. Magnification X 100.

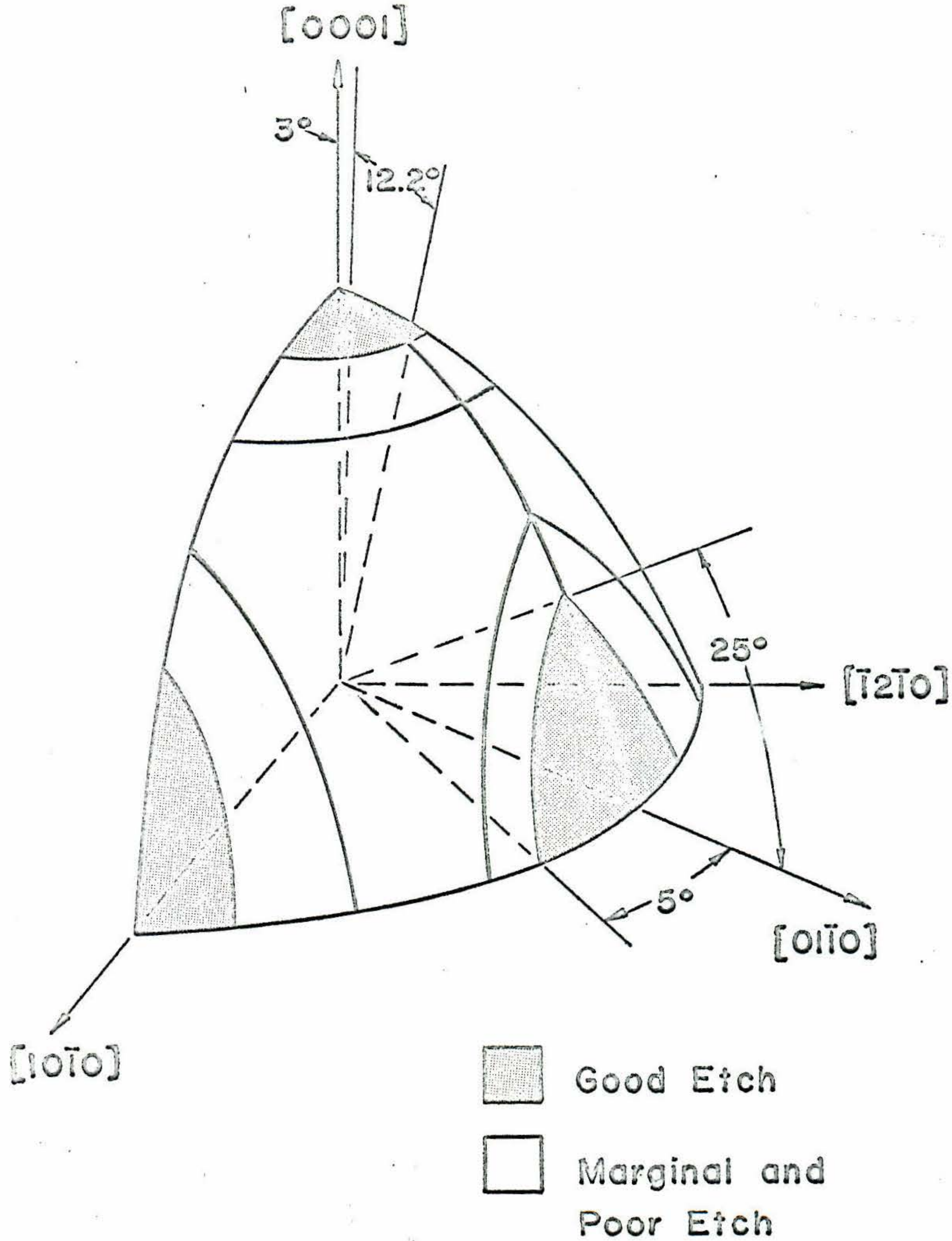
[0001]
3°
12.2°
25°
[1̄21̄0]
5°
[011̄0]
[101̄0]
Good Etch
Marginal and
Poor Etch

Fig. 1.

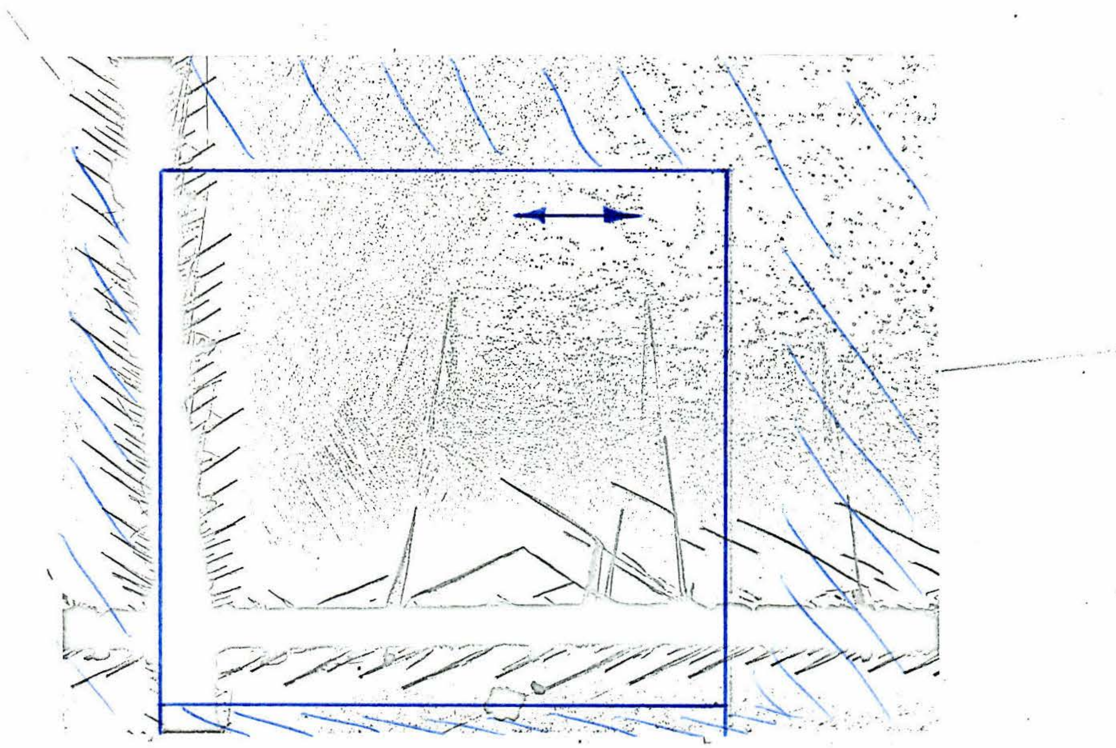

Fig. 2.

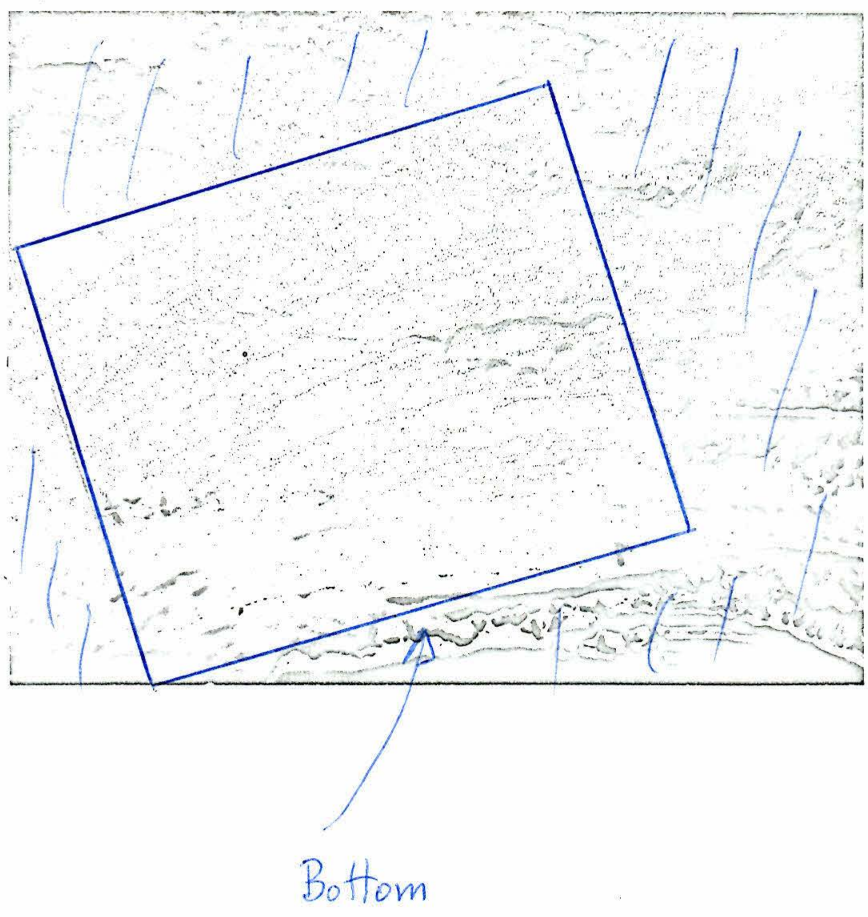

Fig. 3.